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Resource Development Opportunities in Northern Alberta

Alberta
ENERGY AND
NATURAL RESOURCES
Resource Evaluation
and Planning

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RESOURCE DEVELOPMENT OPPORTUNITIES

IN NORTHERN ALBERTA

August, 1985

Alberta
ENERGY AND NATURAL RESOURCES
Resource Evaluation and Planning Division

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1. INTRODUCTION

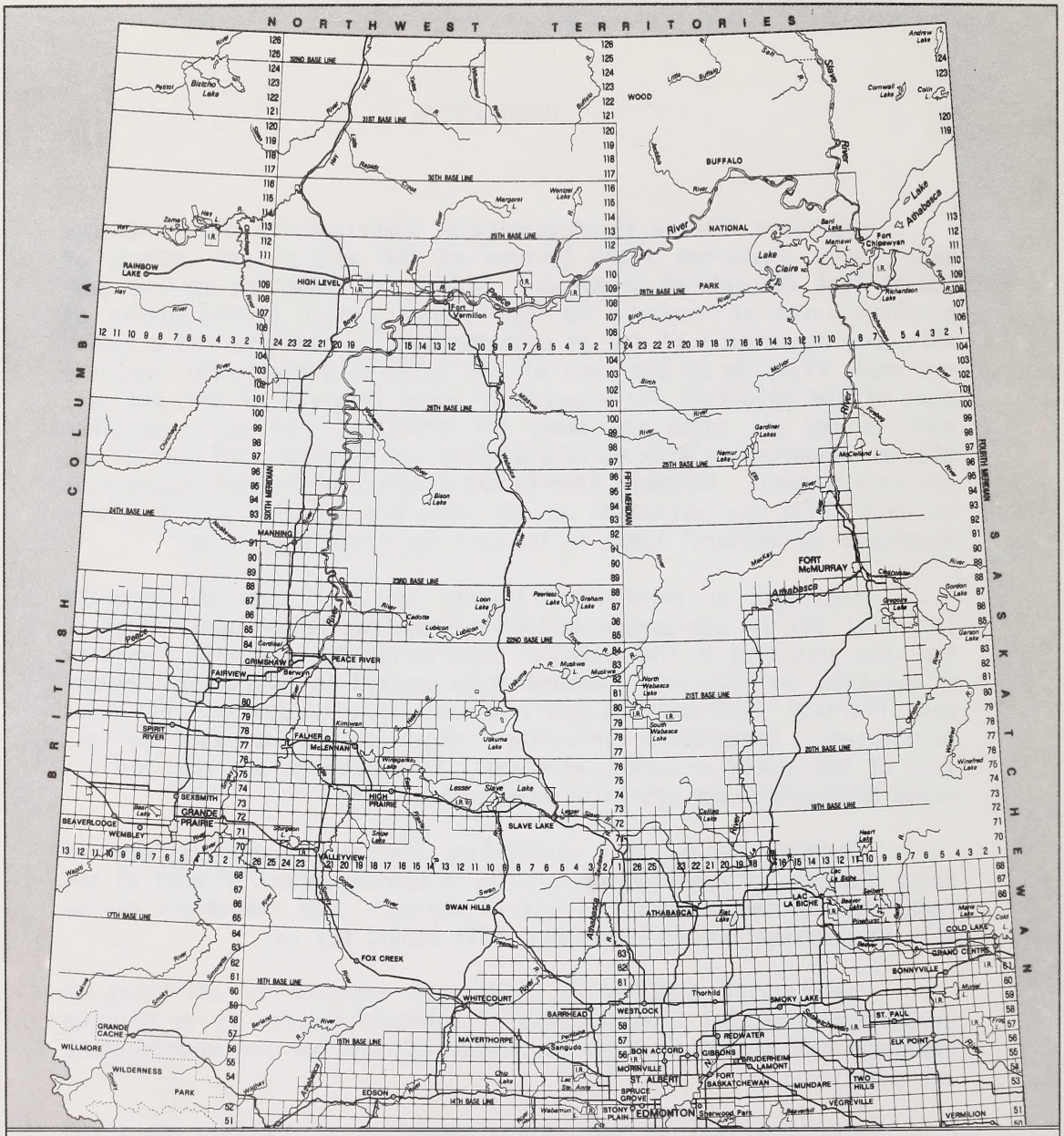
Northern Alberta is of particular importance to Alberta Energy and Natural Resources (ENR) because of the area's vast amounts of public land and natural resources. Figure 1.1 shows the general geographical area of interest for this report; about three-quarters of this area is Crown land and it contains most of the province's timber resource, close to 30 per cent of the existing agricultural land and most of the potential for expansion, known reserves of oil and gas, most of the oil sands and heavy oil deposits, some coal and other mineral resources, a wide variety of fish and wildlife, and most of the province's water. Northern Alberta has experienced limited development to date, with the exception of the Edmonton vicinity and the more developed agricultural lands in the east and Peace River area.

The lack of development (except for that from the minerals industry) and the corresponding lack of commitments throughout most of the area give rise to the potential opportunity for providing a variety of benefits for Albertans. Demands have centred on agricultural expansion (largely localized and small-scale) and oil, gas and oil sands development. Large-scale agricultural expansion and increased utilization of the timber resource, especially the deciduous portion, and oil sands development are promising expectations.

Perhaps the two most significant limitations to fulfilment of these demands and expectations are the dispersed nature of most of the resources and the comparative lack of access. Some industries may be able to overcome these limitations while others may not.

An initial step to an integrated approach to utilizing or developing potential opportunities of northern Alberta is to gain an understanding of the area and its resources, and how the opportunities are interrelated.

The objective of this status report is to identify the broad resource development opportunities in northern Alberta that are directly associated with public lands and resources and are influenced by transportation. No administrative or regional boundaries were adopted for this first step, although information is often presented on a regional basis (e.g., by forest administrative area or by municipality).



RESOURCE DEVELOPMENT OPPORTUNITIES IN NORTHERN ALBERTA

ENERGY AND NATURAL RESOURCES

SCALE 1: 4 000 000

Figure 1.1 Resource Development Opportunities in Northern Alberta, Phase 1 - Status Report Area of Interest.

The information was primarily obtained from previously published sources. The Resource Planning Branch of Resource Evaluation and Planning has completed a situation appraisal for the Peace River Region and is in mid-process of completing one for the Northeast and Athabasca regions. (The situation appraisal technique is a systematic way of surveying and summarizing resource management information for problem solving and decision-making.) The Resource Planning Branch also prepared Economic and Development Trends of Natural Resources in the Northern Alberta Development Council Area in May 1983 for the Northern Alberta Development Council (NADC) to use as back ground for their consultants (Woods Gordon) report on The Development of New Agricultural Land in Northwestern Alberta.

The Alberta Forest Service prepared Location of Future Forest Industry in July 1979. Population and other census information are provided by the Bureau of Statistics, Alberta Treasury. Alberta Economic Development prepared Alberta Industry and Resources, 1982 Edition which contains general descriptions of industries and resources in the province. Alberta Agriculture produced the 1981 Census of Agricultural Data. Alberta Tourism and Small Business commissioned consultants to prepare: Grand Centre/Bonnyville Region Tourism Development Alternatives (May, 1979); Tourism Alternatives for Grande Cache (May, 1979); Battle River Tourism Destination Area Study (March, 1983); Land of the Midnight Twilight Tourism Destination Area Study -- Tourism Inventory and Assessment (March, 1983); Evergreen Tourism Destination Area Study (March, 1984); and Mighty Peace Destination Area Study (March, 1984).

It is important to note that this report is a status report at an overview level of detail, prepared within Alberta Energy and Natural Resources. The report does not provide interpretation nor represent policy or strategy. The report identifies opportunities at a broad level and indicates some factors which should be considered in defining more specific direction for the region.

2. SOCIO-ECONOMICS

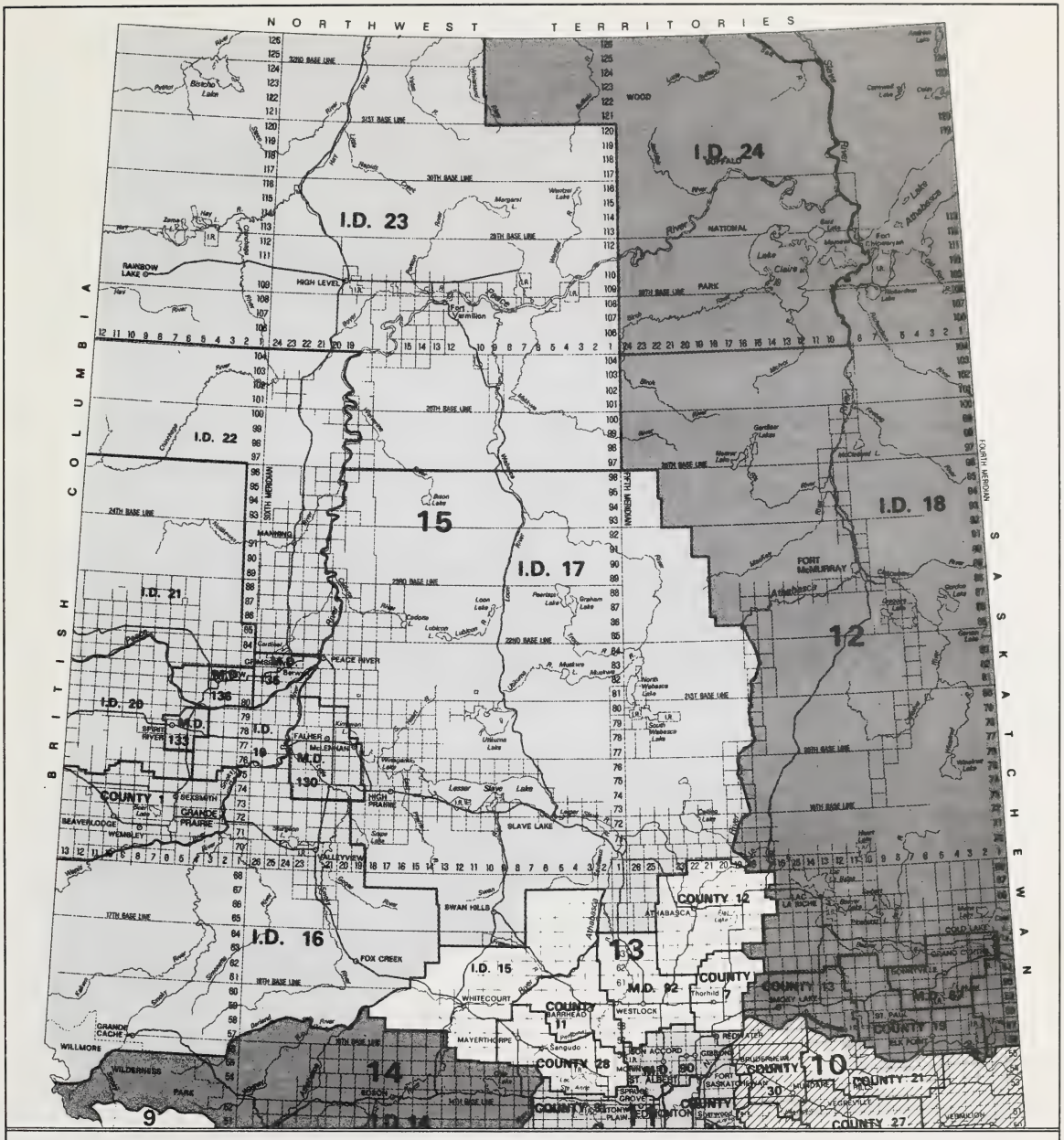
Most of the information presented in this section is organized on the basis of census divisions [CDs] (Figure 2.1); categories are as defined by the Bureau of Statistics. CDs 10, 11 and 12 are partially within the area of interest; CDs 13, 14 and 15 lie entirely within the area of interest.

Table 2.1 shows the population levels and recent growth rates. CDs 10 to 15 have remained fairly constant with about half of the population of the province. When the relatively small area of CD 11 containing Edmonton and vicinity is removed, only 16 per cent of the province's population remains. Annual growth rates for all northern CD except CD 11 exhibited a substantial reduction in 1982, considerably more reduced than the provincial average.

Table 2.2 shows a grouping of the labor resource based on the 1981 census. Group 1 is most directly connected to the natural resource base of northern Alberta while the other groups are indirectly related. Table 2.3 shows the same information in more detail and subdivided by census division.

When CD 11 is excluded from Table 2.2, there is a fairly significant shift in the proportions: Group 1 (those directly employed in resources) becomes 22.2 per cent, Group 2 (those indirectly employed in resources) becomes 25.1 per cent, and Group 3 (the rest of the labor force) becomes 52.7 per cent. This more accurately reflects the direct importance of natural resources in northern Alberta.

An important factor to be noted is that these statistics are based on primary occupation. If a person works at more than one job, then only the one at which the most time is spent is recorded. Many people in northern Alberta depend on more than one employment activity to supplement their "primary" income. For example, new farmers may seek part-time jobs in the forest and petroleum and natural gas industries, as well as in trapping or fishing and service areas. The Woods Gordon study found that very few farmers in the Peace River area are completely dependent on farm income for their livelihood and that off-farm income is especially critical to the beginning farmer. Nearly 10 per cent of the farmers in the Peace River area are employed directly



RESOURCE DEVELOPMENT OPPORTUNITIES IN NORTHERN ALBERTA

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14 CENSUS DIVISION

I.D. 14 COUNTY, MUNICIPAL or IMPROVEMENT DISTRICT

Figure 2.1 Census Divisions and Municipalities, 1982.

Table 2.1

POPULATION AND GROWTH RATES BY CENSUS DIVISION (CD)
1976-1982

	POPULATION			ANNUAL GROWTH RATES (%)	
	1976	1981	1982	1976-81	1981-82
CD 10	67 235	78 395	80 220	3.12	2.33
CD 11*	632 830	762 080	791 870	3.79	3.91
CD 12	63 130	84 225	86 690	5.94	2.93
CD 13	46 300	53 690	54 670	3.01	1.83
CD 14	19 450	24 645	25 560	4.85	3.71
CD 15	105 015	128 645	130 610	3.75	1.53
TOTAL	935 960	1 131 680	1 169 620	3.87	3.35
PROVINCE	1 838 075	2 237 720	2 322 310	4.01	3.78

* CD 11 contains Edmonton and vicinity and is the only northern CD which displayed an increase in the annual growth rate for 1982.

Table 2.2

LABOUR FORCE BY OCCUPATION GROUP
1981 CENSUS, CDS 10-15

	Number	% of Total
Group 1 - Directly Employed in Resources Farming, Fishing and Trapping, Forestry and Logging (including wood, pulp and paper processing), Mining and Quarrying (including oil and gas, mineral, metal, and petro-chemical processing)	55 655	9.8
Group 2 - Indirectly Employed in Resources Other Processing (food and beverage and other), Machining and Related, Product Fabricating, Assembling and Repair, Construction, Transportation Equipment Operating, Material Handling	143 970	25.3
Group 3 - Other Managerial and Administration, Natural Sciences, Engineering and Math, Social Sciences, Teaching and Related, Medicine and Health, Clerical and Related, Sales, Service, Other	369 630	64.9
TOTAL	569 255	100.0

Table 2.3

EMPLOYED LABOR FORCE BY OCCUPATION, 1981 CENSUS

	CD 10	CD 11	CD 12	CD 13	CD 14	CD 15	TOTAL	% of Total
Farming Animal Husbandry and Related	8 370	10 140	3 185	5 690	710	8 385	36 480	6.4
Fishing, Trapping and Related	10	20	40	15	0	65	150	0.0
Forestry and Logging	45	350	210	290	285	1 015	2 195	0.4
Mining and Quarrying (includes oil and gas)	930	3 965	1 075	735	610	2 020	9 335	1.6
Processing								
Mineral and Metal	240	2 305	35	100	20	115	2 815	2.2
Petrochemical	195	1 755	560	40	125	350	3 025	
Food and Beverage	175	4 035	175	125	45	280	4 835	
Wood	20	225	15	250	125	550	1 185	
Pulp and Paper	0	115	0	10	185	160	470	
Other	5	155	5	0	0	5	170	
Machining and Related	805	11 430	815	430	210	985	14 675	2.6
Product Fabricating, Assembling and Repair	1 760	22 660	2 285	1 160	880	3 260	32 005	5.6
Construction	3 665	38 130	4 485	2 480	1 275	5 540	55 575	9.8
Transportation Equipment Operating	1 480	18 450	1 615	1 210	815	3 095	26 665	4.7
Material Handling	475	7 320	585	440	195	1 030	10 045	1.8
Managerial and Administration	2 885	42 445	2 750	1 790	890	4 720	55 480	9.7
Natural Sciences, Engineering and Math	735	18 790	1 215	310	410	1 340	22 800	4.0
Social Sciences & Related	310	6 710	455	165	90	765	8 495	1.5
Teaching and Related	1 350	16 140	1 860	865	465	2 470	23 150	4.1
Medicine and Health	1 585	18 080	1 120	765	250	1 490	23 290	4.1
Clerical and Related	4 570	84 970	4 910	2 625	1 590	7 715	106 380	18.7
Sales	2 440	40 115	2 320	1 580	670	4 015	51 440	9.0
Service	3 320	43 815	6 120	2 215	1 290	5 525	62 285	10.9
Other	1 105	11 175	1 495	605	365	1 865	16 610	2.9
TOTAL	36 475	403 295	37 330	23 895	11 500	56 760	569 255	

by the forest industry, and they make up nearly 30 per cent of the forest sector's work force.

The Woods Gordon study also found that there were strong non-monetary motives related to homesteading and farm development connected to lifestyle and a northern or frontier set of values. These values likely extend into other sectors as well. This will have an effect on what type of development strategies will be most effective. If these "frontier" values translate into a desire for seasonal work to provide cash to support a particular lifestyle, then the creation of full-time jobs in a particular sector will result in the need to draw employment from elsewhere and may not fulfill the expectations within the region the way several smaller, seasonal enterprises might.

A more thorough understanding of these types of relationships, attitudes and interdependencies must be gained before a successful development strategy can be implemented.

3. TRANSPORTATION

Figure 3.1 shows the primary highways and railways in northern Alberta as of 1982. The White Area portion has an extensive highway, road and rail transportation network established. Within the Green Area, access is much more limited. The agricultural portions of the Yellow Area contain fairly good road transportation networks with a rail linkup which extends to Hay River, N.W.T. Barge transportation was supplied on the Athabasca River north of Fort McMurray by Northern Transportation Ltd. until the closing of Uranium City, and now will be supplied by a local business from Fort MacKay to Fort Chipewyan and Uranium City. Barge service is also supplied between Fort Fitzgerald and Fort Chipewyan on the Slave River.

Present major transportation developments include a highway link between Grande Cache and Grande Prairie, and one connecting the isolated northern communities of Conklin, Chard and Janvier with Fort McMurray. The latter road may be extended to Lac La Biche.

There are large areas in northern Alberta with minimal or no improved access. Access that does exist occurs in a north-south pattern. East-west connections are lacking, thus leaving major blocks of land isolated.

There are private roads, primarily built by energy companies, which provide the only access to some areas. These private roads are generally open for public use but other commercial users may be charged for access privileges.

Alberta Transportation plans roads primarily to provide access for communities and to facilitate resource development. The process to provide roads is a long one, usually requiring five years of lead time for a new road and probably double that for a new railway. Since most construction is done on an incremental basis, careful planning is required. Without certain knowledge of future developments, a grid or spine design is generally the most efficient when designing a new road system for an area.

One area currently generating interest is the Sandy Lake-Chipewyan Lake area which has extremely limited access, a number of developing and potential resources and several remote communities. A

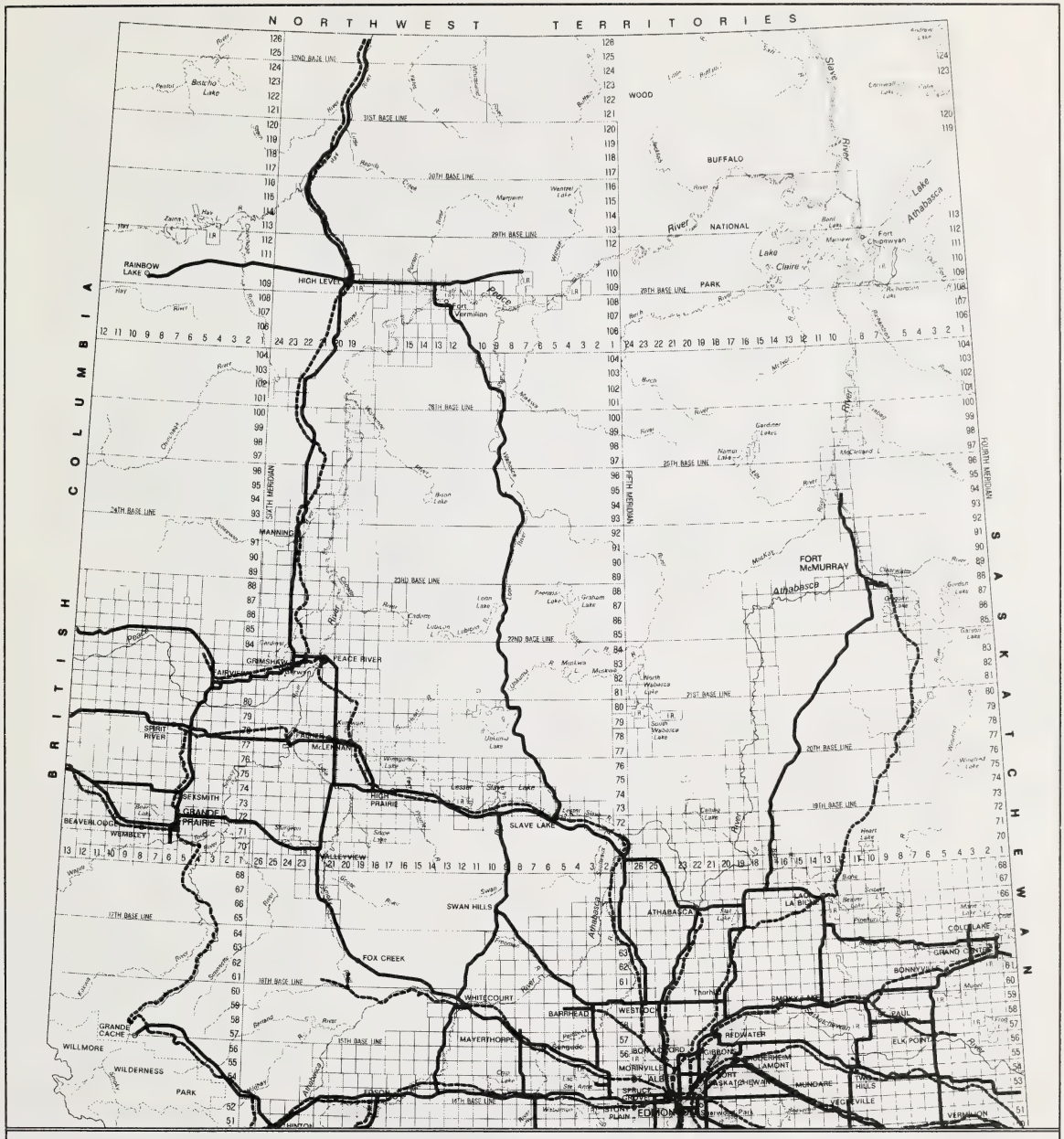


Figure 3.1 Primary Highways and Railways, 1982.

proposal prepared by the private sector (primarily energy companies) for cost-sharing a 495 km (308 mi.) road network is currently being evaluated by the provincial government.

Other areas which are candidates for future construction are: the agricultural expansion areas such as Jean D'Or Prairie and Fort Vermilion across to Garden Creek (and perhaps to Fort Smith); another north-south route on the east side of Alberta, roughly paralleling the Canadian National Railway; a northern extension to access Fort Chipewyan; and an east/west linkage for Fort McMurray, Wabasca, Red Earth, Lubicon, Cadotte, Peace River. Agricultural expansion within the Peace River block will likely only require the construction of lateral roads off existing highways. There has been some discussion by various publics about a road extending from Fort McMurray into Saskatchewan to provide access to recreational lakes.

Pressure to develop access comes primarily from demands by industry and by the public. Industrial demand is generally related directly to resource development. Public demand is for community access (and related development opportunities) and for recreation access. Public demand can also be negative, as in rejecting increased access because of potential effects on lifestyle or increased use of recreation areas.

4. TIMBER RESOURCE

Forests cover nearly two-thirds of Alberta and play an important role in the social, economic and cultural life style of its residents. In addition to their significant and potentially expanding role in the economy of Alberta, forests provide important watershed and recreation benefits and fish and wildlife habitats.

Northern Alberta contains some of the best timber growing sites in the province despite the fact that the Canada Land Inventory rates the land from moderate to low capability. Table 4.1 describes the CLI classes. There is an abundance of CLI class 4 and 5 lands with a small amount of CLI class 3 land. In the extreme north of the province the lands are mainly CLI class 6 and 7.

The principle commercial softwood tree species are jack pine and lodgepole pine and white spruce which are well suited for kraft pulp, lumber and plywood. The principle commercial hardwood species is trembling aspen. Aspen is currently used for waferboard and more recently oriented strand board.

Alberta's forests are subdivided into management units which are managed individually on a sustained yield basis. Long term timber allocations include forest management agreements and timber quotas. The tenures are issued for terms of 20 years and are renewable upon expiry of the term.

The present annual allowable cut in northern Alberta is 12 million m^3 for softwoods and 11 million m^3 for hardwoods (see Tables 4.2 and 4.3). Today 57 per cent of the allowable cut for softwood and only four per cent of the hardwood resource has been committed in the northern forests. There is a significant amount of deciduous growing stock within the northern forest (see Table 4.4); all the Forests except Edson are one-third to one-half deciduous.

Expansion of the forest industry can contribute significantly to the diversity of Alberta's economy. This is especially true in northern Alberta where most of the available uncommitted timber is located. Only the Grande Prairie Forest contains no significant amount of uncommitted coniferous volume (see Table 4.3); the Athabasca, Footner Lake, Lac La Biche, and Slave Lake forests all have 50 to nearly 90 per cent of their coniferous annual allowable cut (AAC) uncommitted.

Table 4.1

CLI FOR FORESTRY CLASSES

CLASS	DESCRIPTION
1	Lands having no important limitations to the growth of commercial forests. Productivity usually greater than 111 cubic feet per acre per year. (There are no Class 1 lands in Alberta.)
2	Lands having slight limitations to the growth of commercial forests. The most common limitations are adverse climate, restricted rooting depth, moderate deficiency or excess of soil moisture, somewhat low fertility, impeded soil drainage, and occasional inundation. Productivity approximately 91-110 cubic feet per acre per year.
3	Lands having moderate limitations to the growth of commercial forests. Most common limitations: adverse climate, restricted rooting depth, moderate soil moisture deficiency or excess, somewhat low fertility, impeded drainage and occasional inundation. Productivity approximately 71-90 cubic feet per acre per year.
4	Lands having moderately severe limitations to the growth of commercial forests. Most common limitations: moisture deficiency or excess, adverse climate, restricted rooting depth, poor structure, excessive carbonates, exposure, or low fertility. Productivity approximately 51-70 cubic feet per acre per year.
5	Lands having severe limitations to the growth of commercial forests. Most common limitations: moisture deficiency or excess, shallowness to bedrock, adverse regional or local climate, low fertility, exposure, excessive stoniness and high levels of carbonates. Productivity approximately 31-50 cubic feet per acre per year.
6	Lands having severe limitations to the growth of commercial forests. Most common limitations: shallowness to bedrock, deficient or excessive soil moisture, high levels of soluble salts, low natural fertility, exposure and stoniness. Productivity approximately 11-30 cubic feet per acre per year.
7	Lands having severe limitations that preclude the growth of commercial forests. Most common limitations: shallowness to bedrock, excessive soil moisture, frequent inundation, active erosion, toxic levels of soluble salts and extremes of climate or exposure. Productivity usually less than 10 cubic feet per acre per year.

Table 4.2

ALLOCATION OF CONIFEROUS ANNUAL ALLOWABLE CUT
(cubic metres)

	Annual Allowable Cut	Forest Management Agreements	Quota and Miscellaneous Use	Uncommitted (%)
Northern				
Athabasca	1 431 516	--	167 146	88
Edson	2 300 248	1 128 480	186 845	43
Footner	1 481 268	--	495 609	67
Grande Prairie	1 692 983	1 602 038	90 718	0
Lac La Biche	709 926	--	130 675	82
Peace River	981 509	9 260	852 534	12
Slave Lake	1 678 466	--	835 127	50
Whitecourt	2 007 245	771 380	782 573	23
Sub-total	12 283 161	3 511 158	3 541 227	43
Other				
Bow Crow	763 924	--	366 543	52
Clearwater Rocky	1 278 041	--	174 634	86
Sub-total	2 041 965		541 177	73
TOTAL	14 325 126	3 511 158	4 082 404	47

Source: Alberta Forest Service, 1984.

Table 4.3

ALLOCATION OF DECIDUOUS ANNUAL ALLOWABLE CUT
(cubic metres)

	Annual Allowable Cut	Forest Management Agreements	Deciduous Timber Allocation	Uncommitted (%)
Northern				
Athabasca	883 815	--	--	100
Edson	615 997	--	99 660	84
Footner Lake	1 978 842	--	--	100
Grande Prairie	1 535 207	--	--	100
Lac La Biche	935 577	--	--	100
Peace River	1 341 664	--	--	100
Slave Lake	2 717 846	250 000*	--	91
Whitecourt	1 104 740	--	76 806	93
Sub-total	11 113 688	250 000	176 466	96
Other				
Bow Crow	90 556	--	--	100
Clearwater Rocky	501 457	--	11 845	98
Sub-total	592 013	--	11 845	98
TOTAL	11 705 701	250 000	188 311	96

Source: Alberta Forest Service, 1984.

* Proposed Weldwood of Canada Ltd. FMA.

Table 4.4

RATIO OF CONIFEROUS TO DECIDUOUS
GROWING STOCK BY FOREST
(Volume)

FOREST	CONIFEROUS	DECIDUOUS
Northern		
Athabasca	67	33
Edson	84	16
Footner	52	48
Grande Prairie	58	42
Lac La Biche	49	51
Peace River	46	54
Slave Lake	47	53
Whitecourt	59	41
Sub-Total	58	42
Other		
Bow Crow	92	8
Clearwater/Rocky	78	22
Sub-Total	85	15
TOTAL	60	40

The areas in northern Alberta available for development are shown in Figure 4.1. On this map the darker shaded areas show more opportunities available; the more lightly shaded areas represent more existing commitments. Even greater potential for expansion of the forest industry exists in the utilization of the hardwood resource.

It is important to recognize that the development of the industry to date was based upon large diameter softwood timber in the most economically viable locations in Alberta. While major expansion opportunities continue to exist there are a number of disadvantages that must be overcome. Most of the remaining timber resource is in northern Alberta and is largely inaccessible at the present time. If any significant development of the forest products industry is to occur, it will require the establishment of a permanent road network and good rail access. This new infrastructure must serve both in providing access to the timber resources and delivery of products to markets.

Four specific areas of the Province require major rail access development for any internationally competitive company to consider development of the timber resource. These areas are: Drayton Valley, Whitecourt, Manning and Athabasca.

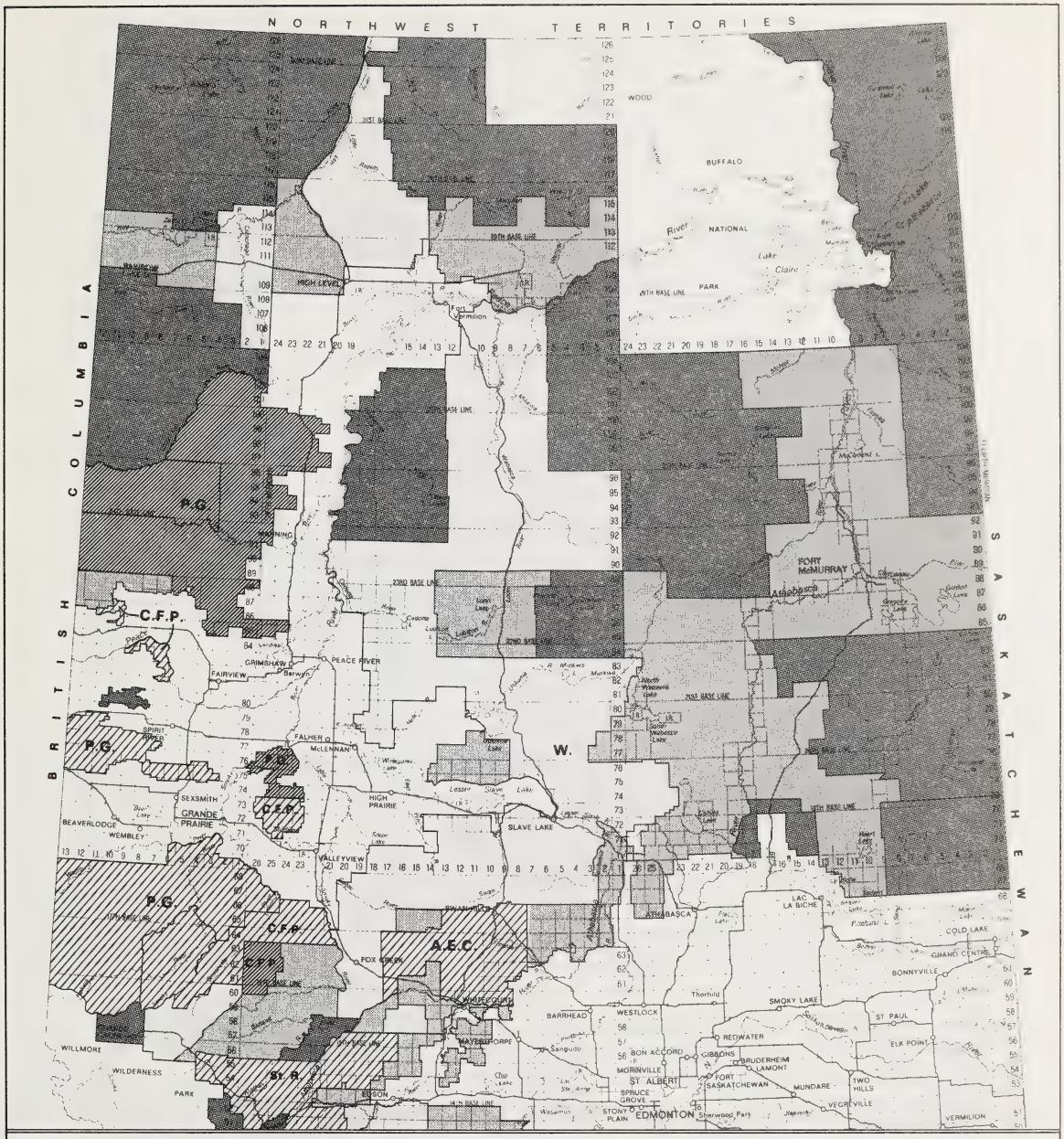
There are two phases to the forestry transportation infrastructure program:

1. Development of a high quality road network in Northern Alberta that will provide access to the resource and transportation of the manufactured product.

2. Development of rail services to provide shipment of the finished products.

The establishment of a good road and rail transportation system for northern Alberta could result in a minimum of 5000 direct jobs related in communities of northern Alberta.

To increase the chances of success in developing the timber resource in northern Alberta requires the integration of deciduous species in the manufacturing process. Increased utilization of the deciduous volume may be possible with new technology such as chemi-thermo-mechanical (CTMP) pulping. The pulp produced may be competitive with bleached kraft pulp in the future but at the present time it is not a market pulp. The fact that a CTMP mill can utilize up to 50:50 blend of coniferous/deciduous fibre and requires a significantly lower initial capital investment than conventional BKP mill, would make CTM



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EXISTING FOREST MANAGEMENT AREAS

AREAS NOT MANAGED FOR TIMBER RESOURCES
(Settled, Metis Colonies, Federal Lands, etc.)

PERCENT OF CONIFEROUS CUT COMMITTED

0% 1-50% 51-100%

PROVISIONAL RESERVE AREAS

St.R.-St. Regis (Alberta) Ltd. C.F.P.-Canadian Forest Products Ltd. A.E.C.-Alberta Energy Company Ltd. W.-Weldwood of Canada Ltd.
P.G.-Procter and Gamble Company of Canada Ltd.

Figure 4.1 Forest Resources, 1985.

pulp an attractive product for the species mix which exist in northern Alberta. Other uses are also important such as the manufacture of waferboard or oriented strand board (Weldwood has a waferboard plant at Slave Lake, and Pelican Spruce Mill has an O.S.B. plant at Edson). These latter uses require significantly lower initial capital investment.

In addition to expanding the forest industry by making available new wood supplies, significant increases can be made by more intensively utilizing smaller timber from existing operating areas. This will require sawmill modernization in terms of re-tooling existing sawmills and adding debarking and chipping facilities. In 1986, the utilization requirements under timber quotas will be changed to achieve this increase in utilization.

New timber processing technologies, sawmill modernization and increased wood supplies by closer utilization will have a positive effect on Alberta's forest economy. Doubling the coniferous harvest could roughly double the number of people employed in harvesting and processing, or an increase of from 3850 to 7700 jobs in northern Alberta, plus any increase due to a "multiplier" effect. These numbers do not include part-time or seasonal work other groups such as those discussed in Section 2.

The forest industry is particularly complimentary to agriculture development in northern Alberta providing off-season employment opportunities. Furthermore, it is an industry whose expansion could have an important impact in providing employment opportunities for Indians and Metis people in northern Alberta.

5. AGRICULTURE

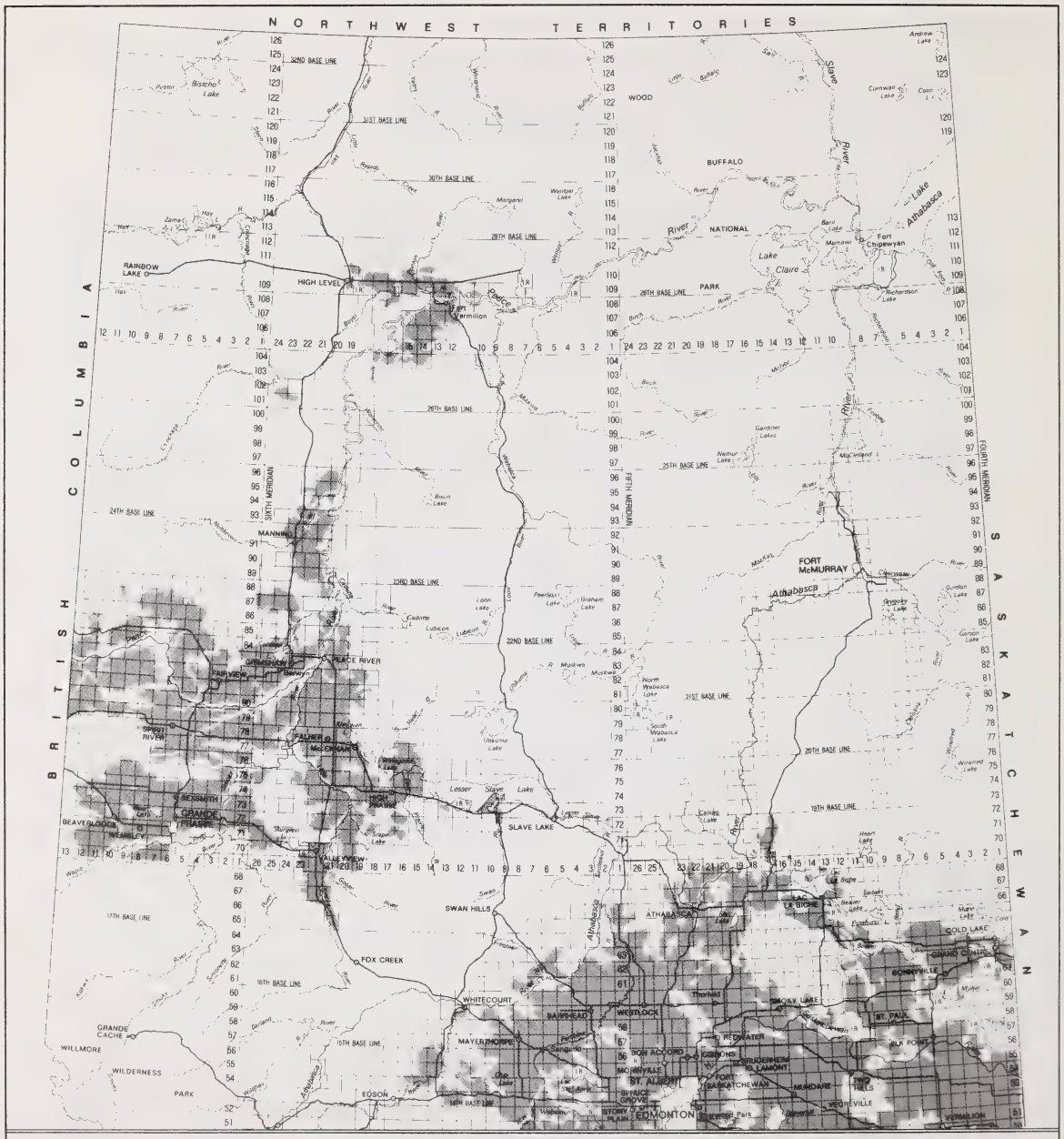
There are two distinct areas of agriculture in northern Alberta. Within ENRs Northeast Region lies the northernmost portion of the White Area, which contains the bulk of Alberta's farmland. The Yellow Area in the Peace River Region is gaining importance in the provincial agricultural scene as the only remaining potential source of undeveloped public land suitable for significant expansion.

While there are CLI class 1 lands around Edmonton, along the Green/White fringe and in the Peace River Region, the best lands are class 2 and 3. Figure 5.1 shows the present distribution of cultivated land.

During the period of 1976-1980, 280 000 acres (113 314 ha) of public land were added to the agricultural land base in the Peace River Region. Only 27 per cent (76 000 acres, 30 757 ha) was class 2 or 3, 52 per cent (146 000 acres, 59 085 ha) was class 4, and the remaining 21 per cent (58 000 acres, 23 472 ha) was class 5 or poorer.

There is little good agricultural land (CLI classes 2 and 3) remaining to be developed in northern Alberta. It is estimated at one million acres (404 694 ha) within the Green Area with an additional nine million acres (3 642 250 ha) of potentially arable (CLI class 4) and 18 million acres (7 284 500 ha) capable of being used as unimproved pasture (CLI class 5). These lands are scattered through the Peace River Region and extend slightly to the northwesterly portion of the Northeast Region. Some of these lands are committed to other uses and/or are significant for providing other benefits in other sectors.

The erratic climate in the Peace River Region encourages an emphasis on the production of coarse grains such as barley and oats, oilseeds such as canola and forage crops. Approximatey 70 per cent of the soils suitable for agriculture require liming to raise the soil pH to reach full growth potential. Lime at present is trucked in from Exshaw. Road development requires well-engineered ditching and/or drainage or erosion can become a big problem. The northern portion of the White Area also produces barley and displays a much greater emphasis on livestock (especially beef cattle), with mixed farms predominating. Extensive areas of solonetzic soils affect crop yields.



RESOURCE DEVELOPMENT OPPORTUNITIES IN NORTHERN ALBERTA

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CULTIVATED LANDS

Figure 5.1 Present Agricultural Use.

All of these factors have the effect of increasing the costs of agricultural development and production.

Tables 5.1 and 5.2 present selected statistics with the municipalities in two groups: fringe and northern (those municipalites which contain portions of the Green Area and those in the Peace River Region) and the other municipalities in northern Alberta. The fringe and northern municipalities generally contain farms that are larger (at an average of 667 acres or 270 ha per farm) than the other farms in northern Alberta (575 acres or 233 ha per farm), but still smaller than the provincial average (813 acres or 329 ha per farm). Northern Alberta farms report considerably more off-farm employment (with 49 per cent) than do farms in the rest of the province (with 12 per cent). Average farm capital also shows differences with the fringe and northern farms reporting a lower average ($384 000 per farm) than the other northern Alberta farms ($467 000 per farm), and both being considerably below the provincial average ($634 000 per farm).

The provincial government's goal is to post 250 000 acres (101 174 ha) of public land annually over the next four to five years in the Peace River Region (roughly CD 15). Table 5.3 presents estimates that, other things being equal, this would effect a 20 per cent increase in the other statistics, such as number of farms, farm population and the farm labor force.

Table 5.3 also presents estimates for a higher level of increase (five million acres, 2 023 472 ha) which would produce an 80 per cent increase in the same figures. As with the development of any resource opportunity, certain multiplier effects would be felt in the region and throughout the province. Table 5.3 contains a number of assumptions, including the availability of off-farm employment.

All expansions will require an expanded and upgraded transportation system in order both to permit access to the increased farm area and to accommodate the movement of the increased production. This will add significantly to the costs.

Due to both the lower capability of most of the remaining land in the area and the high costs associated with farm establishment, increased agricultural opportunities will be dependent on off-farm employment opportunities, probably in the forestry and energy sectors.

Table 5.1
NUMBER OF FARMS, AVERAGE AREA, TOTAL AREA AND
TOTAL IMPROVED AREA (1981 CENSUS)

	Number of Farms	Average Area per Farm (acres)	Total Farm Area (acres)	Total Improved (acres)	Total Improved (%)
Fringe and Northern					
ID 14	818	478	391 455	219 204	(56)
ID 15	283	546	154 527	86 371	(56)
ID 16	856	672	575 593	339 925	(59)
ID 17	1 032	716	738 616	458 838	(62)
ID 18	756	676	511 379	236 465	(46)
ID 19	806	888	715 486	555 782	(78)
ID 20	956	752	719 465	540 866	(75)
ID 21	618	932	575 723	349 236	(61)
ID 22	812	736	597 724	404 572	(68)
ID 23	578	703	406 550	264 618	(69)
MD 87	682	586	399 647	275 034	(69)
MD 130	669	816	546 164	457 034	(84)
MD 133	Not available separately, included with ID 20				
MD 135	275	701	192 912	145 961	(76)
MD 136	Not available separately, included with ID 19				
Cty 1	1 637	635	1 038 911	750 310	(72)
Cty 11	967	473	457 820	343 006	(75)
Cty 12	1 054	574	605 458	385 699	(64)
Cty 13	691	526	363 780	254 745	(70)
Sub-total	13 440	667	8 991 210	6 067 775	(67)
Other:					
MD 90	1 664	422	491 395	431 047	(88)
MD 92	1 137	520	591 696	481 428	(81)
Cty 7	829	469	388 889	286 816	(74)
Cty 13	691	526	363 780	254 745	(70)
Cty 19	994	631	626 948	403 411	(64)
Cty 20	1 053	260	273 664	223 067	(82)
Cty 21	958	628	601 930	446 326	(74)
Cty 28	1 172	487	436 332	379 339	(87)
Cty 30	1 245	433	539 579	450 170	(83)
Cty 31	1 350	398	536 951	372 000	(69)
Saddle Lake	15	657	9 857	6 303	(64)
Sub-Total	11 108	438	4 861 021	3 734 652	(77)
Northern Total	24 598	575	13 852 231	9 802 427	(71)
PROVINCIAL TOTAL	58 056	813	47 218 170	30 951 142	(66)

Table 5.2
FARM POPULATION, FARMS REORTING OFF-FARM WORK,
AND AVERAGE FARM CAPITAL (1981 CENSUS)

	Farm Population	Farms Reporting Off-Farm Work (%)	Average farm capital ($000)
Fringe and Northern			
ID 14	2 765	431 (53)	296
ID 15	964	160 (57)	317
ID 16	2 977	554 (65)	296
ID 17	3 474	622 (60)	319
ID 18	2 940	401 (59)	300
ID 19	2 577	334 (41)	449
ID 20	2 966	487 (51)	357
ID 21	2 127	354 (38)	349
ID 22	2 594	471 (64)	289
ID 23	2 847	370 (54)	288
MD 87	2 600	334 (49)	433
MD 130	2 153	311 (38)	469
MD 133	Not available separately, included with ID 20		
MD 135	925	134 (49)	436
MD 136	Not available separately, included with ID 19		
Cty 1	5 479	879 (54)	453
Cty 11	3 388	408 (42)	373
Cty 12	3 413	303 (29)	608
Cty 13	2 048	326 (47)	348
Sub-total	46 237	6 879 (51)	384
Other			
MD 90	4 195	565 (49)	846
MD 92	3 992	502 (44)	481
Cty 7	2 100	394 (48)	335
Cty 13	2 048	326 (47)	348
Cty 19	3 623	424 (43)	350
Cty 20	3 727	537 (51)	1 260
Cty 21	2 735	361 (38)	419
Cty 28	3 811	565 (48)	339
Cty 30	3 342	608 (49)	388
Cty 31	4 615	748 (55)	622
Saddle Lake	76	2 (13)	included with ID 18
Sub-Total	34 264	5 032 (45)	485
Total	80 501	11 911 (49)	467
PROVINCIAL TOTAL	195 284	24 087 (12)	634

Table 5.3

FARM AREA, POPULATION, AND LABOUR FORCE PROJECTIONS

	1981 Census	1986 Projection*	High Projection**
Number of Farms	8 239	9 925	14 984
Total Farm Area (acres)	6 107 144	7 357 144	11 107 144
Farm Population	28 119	33 873	51 139
Labour Force in Farming, Animal Husbandry and Related	8 385	10 101	15 250
Number of Farms Reporting Off-Farm Employment	4 516	5 440	8 213

* Based on 250 000 acres per year for five years and other variables (e.g., size of farms, population per farm) constant.

** Based on an increase in the agricultural land base of five million acres with other variables constant.

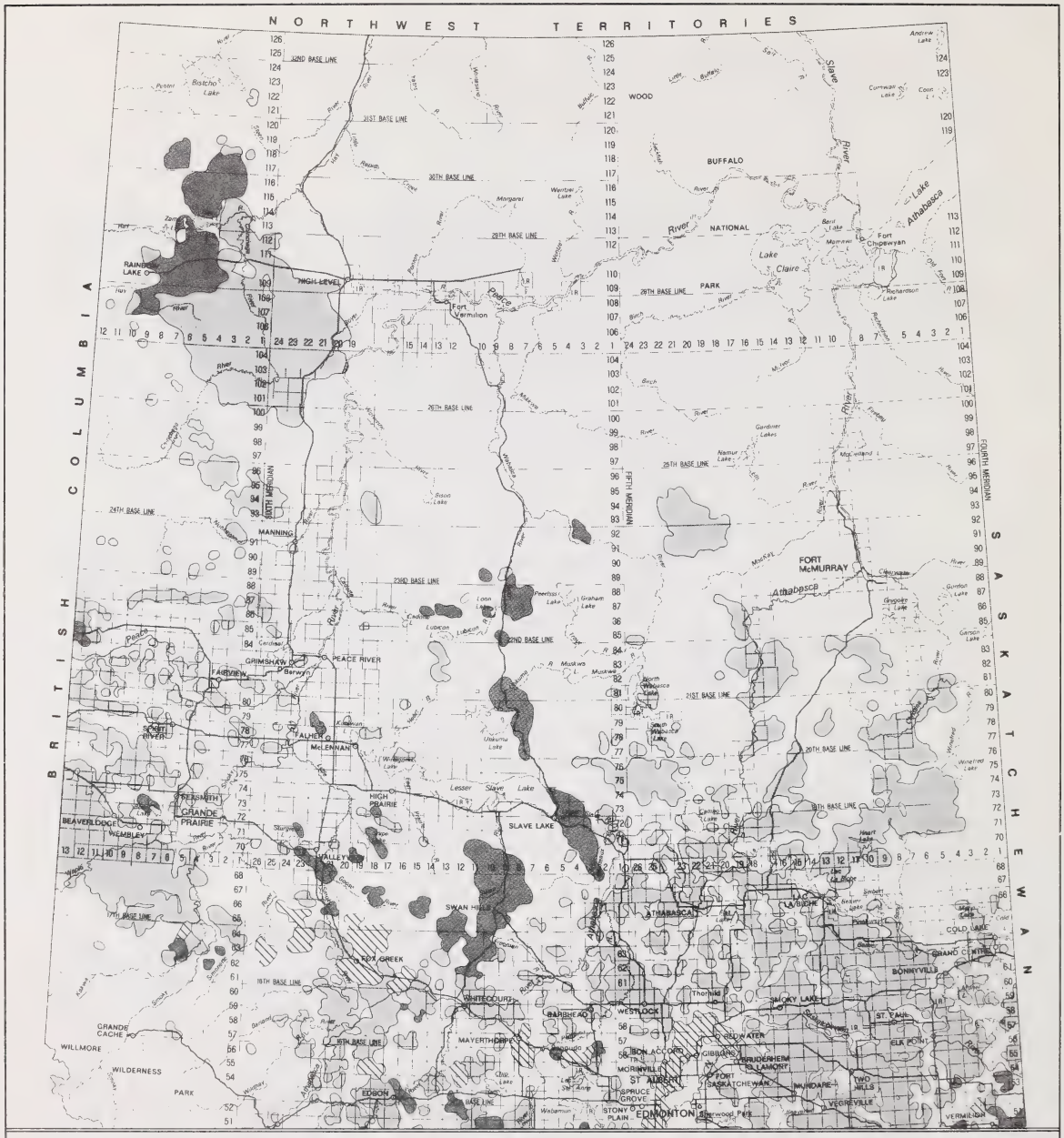
6. PETROLEUM AND NATURAL GAS

Most of northern Alberta is underlain by oil and gas fields (see Figure 6.1). Exploration and development have and will continue to be an important part of the economy. Figure 6.2 shows the distribution of major pipelines to transport the product and the location of the 29 main gas processing plants in northern Alberta (in 1982). Production may now begin to recover from the slump caused by a decline in demand and reduction in the export market, the tougher economy and the effects of the National Energy Program. The petrochemical industry was also affected, causing many planned projects to be cancelled or postponed.

The present focus of activity is oil, but as the natural gas market improves the Deep Basin area will attract more attention. Drilling activity is closely related to the expiry of leases, joint venture commitments, debt retirement, interest rates, limited markets and government incentives which interact to make forecasting of drilling activity precarious.

The Liege, Saleski and Granor gas fields and an in-situ oil sands Sandy Lake-Chiperry pilot plant, lie within the area of Sandy Lake-Chipewyan Lake where road access is severely limited. This area has recently been studied by a private consultant on behalf of energy companies (and Alberta Transportation) to determine the most efficient solution to this lack of access.

The 1981 census showed 15 175 people directly employed in northern Alberta in mining, quarrying and processing. This does not reflect part-time or seasonal employment by groups such as farmers or those involved in forestry.



RESOURCE DEVELOPMENT OPPORTUNITIES IN NORTHERN ALBERTA

ENERGY AND NATURAL RESOURCES

SCALE 1: 4 000 000

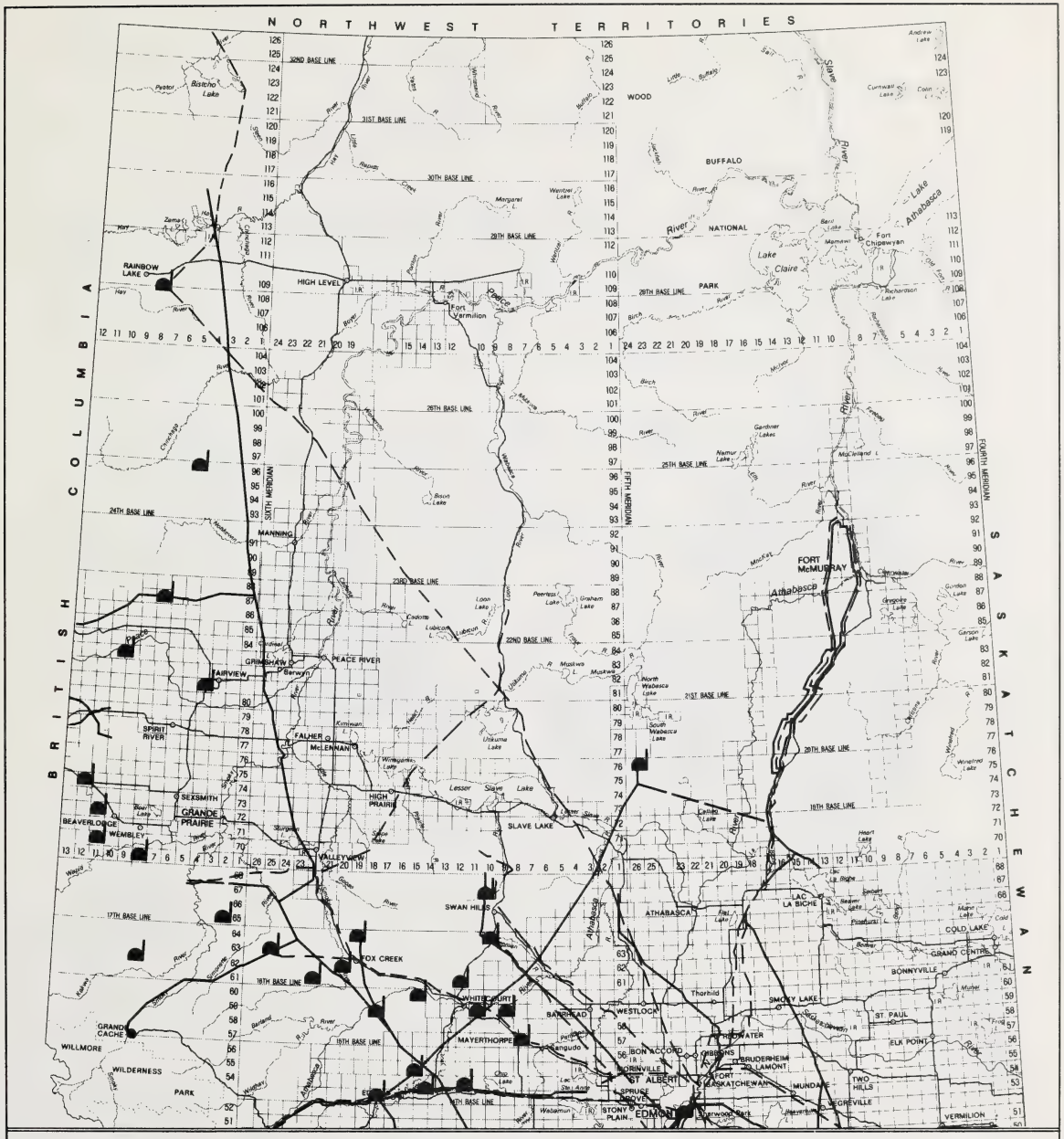
OIL FIELD

GAS FIELD

OIL AND GAS FIELD

Figure 6.1 Oil and Gas Pools, 1982.

SOURCE: Alberta Bureau of Surveying and Mapping.



RESOURCE DEVELOPMENT OPPORTUNITIES IN NORTHERN ALBERTA

ENERGY AND NATURAL RESOURCES

SCALE 1: 4 000 000

– – MAIN OIL PIPELINE

— MAIN GAS PIPELINE

MAIN GAS PROCESSING PLANT

Figure 6.2 Main Pipelines and Gas Plants, 1982.
SOURCE: Alberta Bureau of Surveying and Mapping.

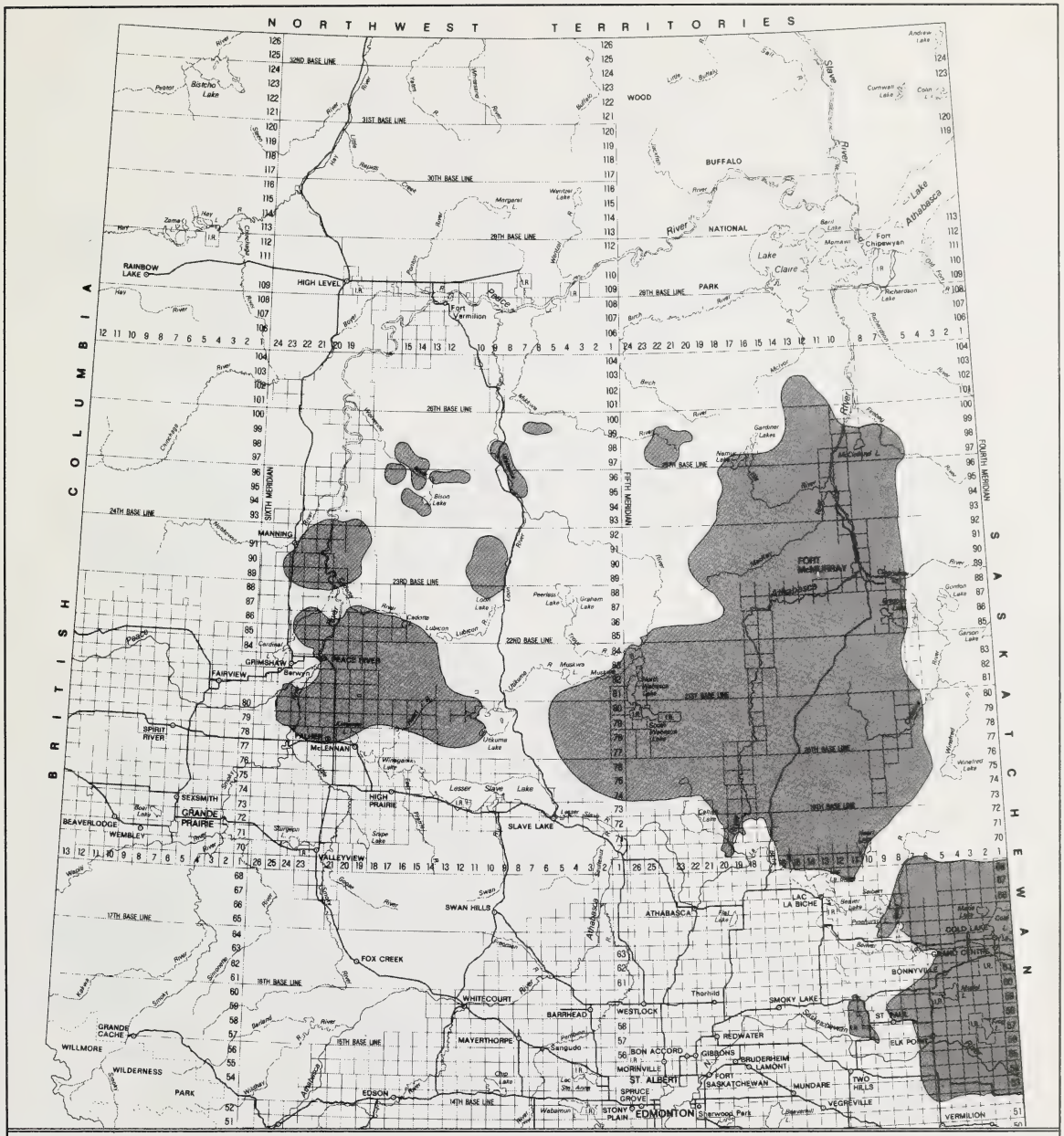
7. OIL SANDS

Northern Alberta contains almost all of the province's deposits of oil sands (Figure 7.1). The economically-surface-mineable oil sands are located within a 40 km (25 mi.) wide corridor along the Athabasca River north of Fort McMurray. Syncrude and Suncor are at present producing. Syncrude plans to expand the area being mined and Suncor is speeding up its mine plan.

In-situ development is proceeding in areas where the reserves are buried more deeply. Seventy-nine pilot or experimental projects are being carried out on oil sands and heavy oil deposits but no new massive "mega-projects" are predicted. Smaller projects are being announced such as the Wolf Lake project (450 construction and 200 permanent jobs), the scaled-down Esso Cold Lake project (200 fabrication and 200 construction jobs) and the proposed scaled-down version of Shell's Peace River in-situ plant. Other projects include AOSTRAs underground test facility now under construction near Fort McMurray, Union Oil's plan for a heavy oil plant at Buffalo Creek, and the recent announcement by Petro Canada and Nova of proposed development on the former Alsands site.

Interest in developing the oil sands deposits is gaining momentum. Some pilot and experimental projects within the Cold Lake deposits are being advanced to production facilities. Industry analysts have estimated that an average development would create 400-450 construction jobs (temporary) and 200 full-time jobs (permanent). A multiple effect on employment would be incurred as well. Interest is also being expressed again in new developments in the Athabasca surface mineable oil sands deposits, the in-situ Wabasca deposits and the in-situ Peace River deposits (where Shell Canada has announced its intention of converting its pilot plant to commercial production).

Because most of the oil sands deposits are found within the Green Area it is not anticipated that there will be any direct impact on agriculture. These developments do, however, place a high demand on the water resource (as does the development of the heavy oil resource immediately south of the eastern portion of the study area). Allocation of the water resource among oil sands development, agriculture and other users will be an important factor in resource development and use in the future.


NORTHWEST TERRITORIES
BRITISH COLUMBIA
SASKATCHEWAN
FOURTH MERIDIAN
FIFTH MERIDIAN
SIXTH MERIDIAN
WOOD BUFFALO NATIONAL PARK
RAINBOW LAKE
HIGH LEVEL
Fort Vermilion
MANNING
PEACE RIVER
FAIRVIEW
GRIMSHAW
Berwyn
SPIRIT RIVER
McLENNAN
SEXSMITH
GRANDE PRAIRIE
BEAVERLODGE
WEMBLEY
HIGH PRAIRIE
VALLEYVIEW
SLAVE LAKE
Lesser Slave Lake
SWAN HILLS
FOX CREEK
WHITECOURT
BARRHEAD
MAYERTHORPE
Sangudo
EDSON
WILLMORE WILDERNESS PARK
GRANDE CACHE
Fort McMURRAY
Athabasca
ATHABASCA
LAC LA BICHE
COLD LAKE
CFB CENTRE
BONNYVILLE
ELK POINT
Thorhild
SMOKY LAKE
WESTLOCK
REDWATER
GIBBONS
BRUDERHEIM
LAMONT
BON ACCORD
MORINVILLE
ST. ALBERT
FORT SASKATCHEWAN
MUNDARE
TWO HILLS
VEGREVILLE
VERMILION
SPRUCE GROVE
STONY PLAIN
EDMONTON
Sherwood Park
Wabamun
Chip Lake
Lac Ste. Anne
Pembina
Smoky
Wapiti
Simonette
Kakwa
Wentzel Lake
Margaret L.
Bistcho Lake
Peace
Hay
Zama L.
Meikle
Rainbow
Boyer
Birch
Richardson Lake
Gardiner Lakes
Namur Lake
Gregoire Lake
Gipsy Lake
Gunton Lake
Garson Lake
Winefred Lake
Wandering River
Calling Lake
Utikuma Lake
Loon Lake
Bison Lake
Peerless Lake
Graham Lake
Cadotte Lake
Lubicon Lake
Musketa L.
Utikuma
Sturgeon L.
Snipe Lake
Swan
Sturgeon
Whitemud
Pembina
Paddle
Sakwatamau L.
Lac Ste. Anne
Namao
Fort Chipewyan
Lake Athabasca
Claire
Andrew Lake
Cumwan Lake
Colin L.
Salt
Slave
Buffalo
Birch
Richardson
Gardiner
Namur
Gregoire
Gipsy
Gunton
Garson
Winefred
Wandering
Calling
Utikuma
Loon
Bison
Peerless
Graham
Cadotte
Lubicon
Musketa
Sturgeon
Snipe
Swan
Whitemud
Pembina
Paddle
Sakwatamau
Namao
Andrew
Cumwan
Colin

8. COAL AND OTHER RESOURCES

Figure 8.1 shows the coal types and existing mines in northern Alberta. Coal exploration in the area is at a low level, and no new mining is being planned. There is the potential for the development of coal for thermal power generation in five locations: Lesser Slave Lake (750 MW), Judy Creek (2250 MW), Fox Creek (750 MW), Picardville (750 MW) and Isle Lake (1500 MW). These sites will not be developed until justified by demand.

Northern Alberta also contains many other mineral resources; a selection of some potentially economically viable ones is shown in Figure 8.2. These include limestone, gypsum, silica sand, dimensional stone, uranium, iron and various heavy metals. Each of these has received at least preliminary exploration but no significant development is forecast.

Extensive deposits of peat can be found in northern Alberta (approximately 35 000 km^2, 13 510 $mi.^2$)), primarily of moderate to low quality and generally not easily accessible. Most of the commercial use at present is for agriculture and horticulture with most of the peat exported.

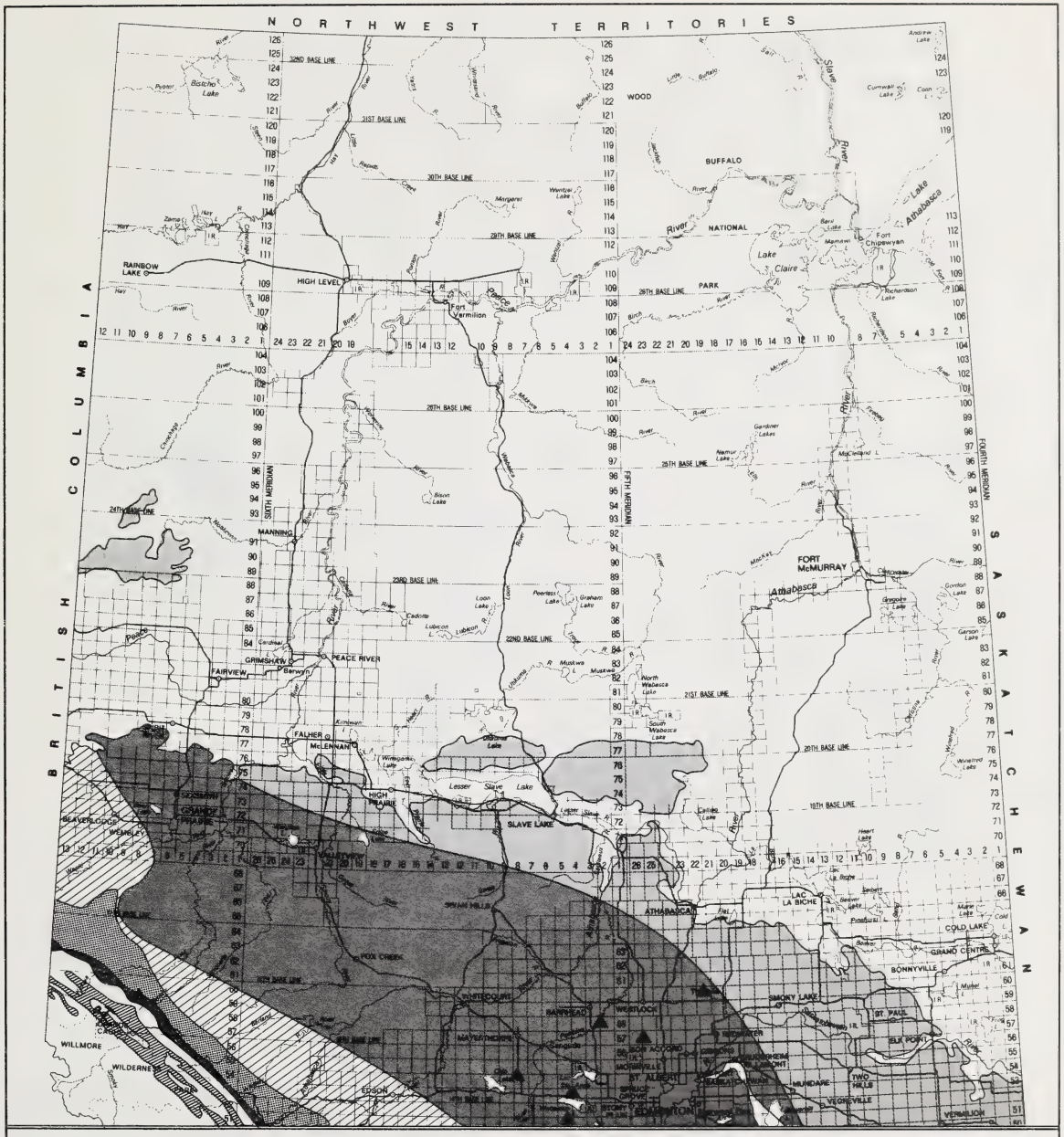
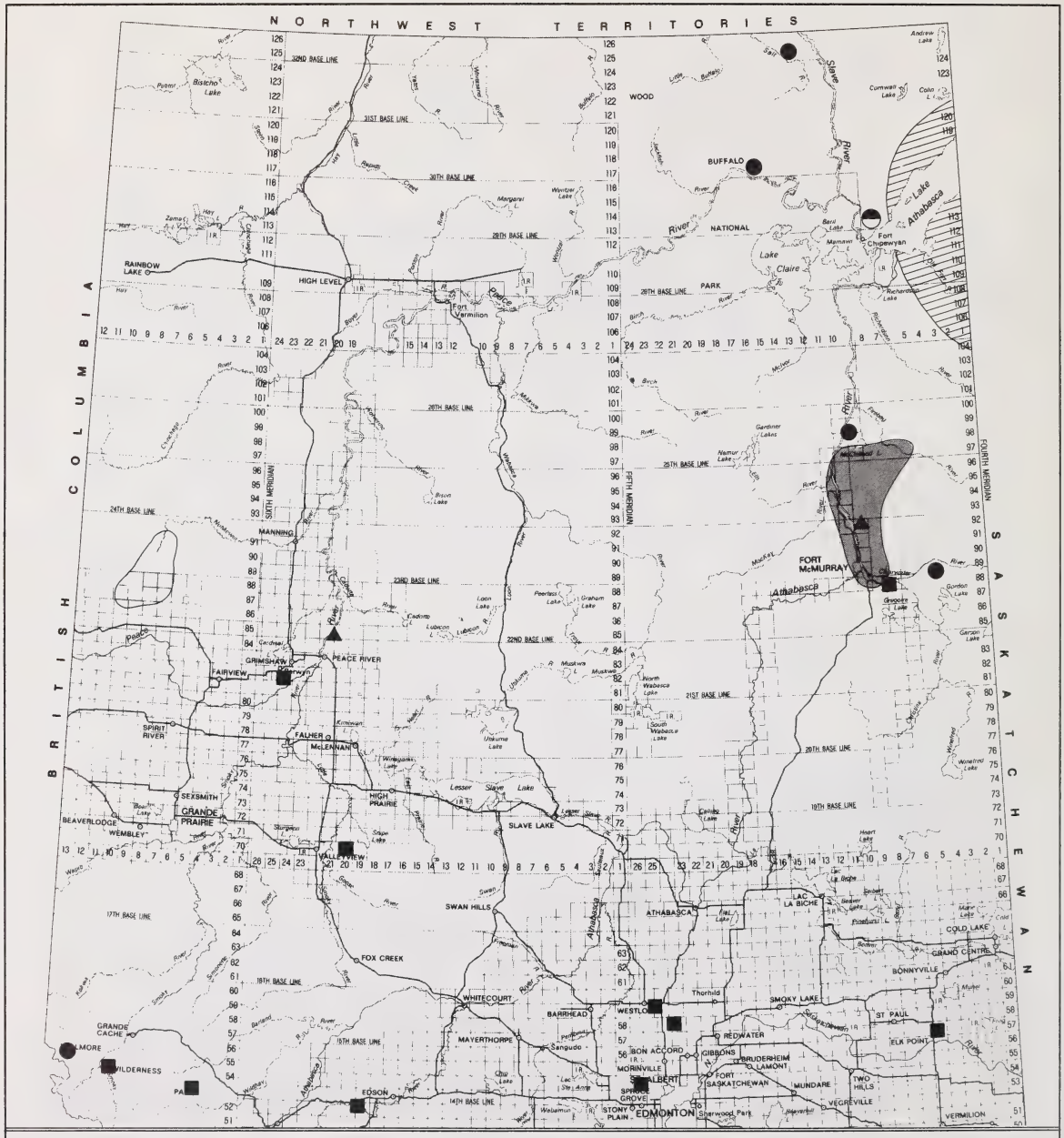

NORTHWEST TERRITORIES
BRITISH COLUMBIA
SASKATCHEWAN
RESOURCE DEVELOPMENT OPPORTUNITIES IN NORTHERN ALBERTA
ENERGY AND NATURAL RESOURCES
SCALE 1: 4 000 000
SURFACE MINE
UNDERGROUND MINE
PLAINS REGION
LIGNITE (Less than 19 300 kJ/kg)
SUB-BITUMINOUS (19 300-23 300 kJ/kg)
HIGH VOLATILE BITUMINOUS (23 300-30 200 kJ/kg)
FOOTHILLS REGION
HIGH VOLATILE BITUMINOUS (23 300-30 200 kJ/kg)
MEDIUM and LOW VOLATILE BITUMINOUS (25 600-33 700 kJ/kg)
MOUNTAIN REGION
MEDIUM and LOW VOLATILE BITUMINOUS (25 600-33 700 kJ/kg)

Figure 8.1 Coal and Existing Mines, 1982.
SOURCE: Alberta Bureau of Surveying and Mapping.



RESOURCE DEVELOPMENT OPPORTUNITIES IN NORTHERN ALBERTA

ENERGY AND NATURAL RESOURCES

SCALE 1: 4 000 000

- IRON FORMATION
- URANIUM (Prospective Area)
- VANADIUM, NICKEL, TITANIUM AND ZIRCONIUM (Oil Sands Area)
- GYPSUM DEPOSIT
- SILICA SAND DEPOSIT
- DIMENSIONAL STONE DEPOSIT
- LIMESTONE-MARLCOQUINA DEPOSIT

Figure 8.2 Selected Other Mineral Resources, 1982.

SOURCE: Alberta Bureau of Surveying and Mapping.

9. FISH AND WILDLIFE

Northern Alberta has a large and varied habitat base that produces a broad variety of wildlife.

The major species trapped are lynx, coyote, muskrat and beaver (varies with market and population fluctuations). While there is no potential to increase the number of traplines, the level of resource management could be intensified to increase production. The 1981 census identifies only 65 people (full-time) in the trapping and related occupation categories, but there are approximately 2 000 registered trappers in the Northern Alberta Development Council area (slightly smaller than the area being looked at in this report). Approximately one-quarter of these registered trappers are farmers. The average trapline generates about $2 500 - $3 000 a year, but a few trappers make $40 000 - $50 000 a year. Traplines will be adversely affected by increased major expansions in surface disturbances and agricultural expansion.

In terms of recreation opportunities, the primary hunted species are moose, elk, black bear and deer. The area is attractive to waterfowl hunters, especially in the agricultural areas. Much of the hunting pressure is generated in central Alberta, and access (particularly in resource exploration and development areas) gives rise to increased use. Direct employment related to the recreatioal use of the wildlife resource includes 37 class A and 274 class B guides in the Peace River Region, but the area is also used by southern guides. These are usually not full-time jobs. Other employment opportunities are created in various associated sectors such as the service industry.

The total annual cumulative value of the guiding industry in the Peace River Region is estimated at $7.5 million.

Some interest has been expressed in developing game farms or wildlife ranches as this opportunity was endorsed in the Fish and Wildlife Policy released in 1982. In particular, the possibility may be very applicable to Indian reserves or Metis settlements, although it may also be considered on private land.

Commercial fishing lakes are shown in Figure 9.1; Lesser Slave, Utikuma and Cold lakes, Lac La Biche and Lake Athabasca are the most

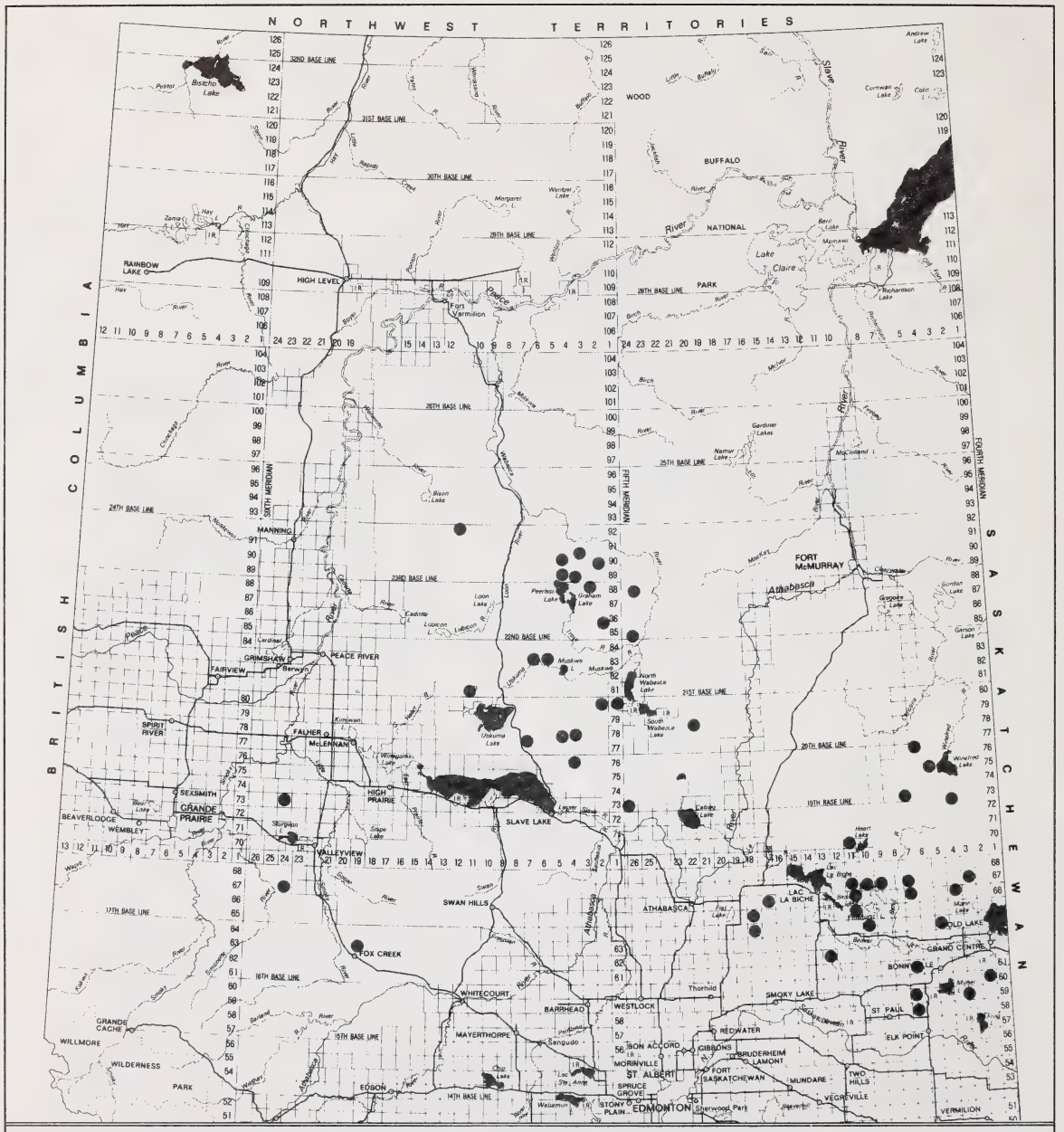


Figure 9.1 Commercial Fishing Lakes.

important commercially. The 1981 census lists 85 people in net, trap and line fishing and related occupations while there are approximately 1 000 licensed commercial fishermen in the Northern Alberta Development Council area. The average income from fishing in 1979 was $1 000, while fewer than 10 per cent make more than $9 000. There is little potential for growth of the industry. The Freshwater Fish Marketing Corporation is evaluating sites for a fish packing plant near Fort Chipewyan to reduce shipping costs.

Fly-in recreational fishing is quickly developing to a significant scale in the Northeast Region with activity having doubled over the last few years. This may have an effect on the ability of northern lakes to sustain a viable fishery as well as posing other land use conflicts.

Transportation's biggest effect is providing access for recreation purposes. Transportation is generally not a limiting factor to commercial uses of the fish and wildlife resource, except in the case of product transport from some commercially fished lakes such as Lake Athabasca.

10. WATER RESOURCES

Over 90 per cent of the mean annual river discharges in the province comes from northern Alberta (Table 10.1), and over 80 per cent exits via the Slave River in the northeast. Figure 10.1 shows potential hydroelectric sites.

Drainage is a major water concern in the Peace River Region, especially as related to road construction. Soil properties and very long slopes combine to create ponding and erosion problems. Heavy oil and in situ oil sands development in the Cold Lake-Lloydminster area will exert a water demand which may overwhelm the capacity of the area to supply. The possibility of water transfer via pipeline from the North Saskatchewan River or the Athabasca River is being investigated. Water supply during winter low flow could also eventually become a limiting factor in the development of the oil sands deposits north of Fort McMurray as all current extraction techniques have a very high water demand. Alberta Environment is the primary department responsible for the management of the water resource.

Table 10.1

MEAN ANNUAL RIVER DISCHARGES

	000 000 m^3	000s acre feet
Northern Alberta		
Petitot	659.4	535
Hay	3 359.0	2 723
Whitesand and Buffalo	1 128.0	914
Slave (Peace & Athabasca)	109 980.0	89 162
Beaver	891.1	722
North Saskatchewan	7 118.0	5 771
Sub-total	123 135.5	99 827
Southern Alberta		
Battle	294.6	239
Red Deer	1 842.0	1 493
South Saskatchewan	5 882.0	4 769
Milk	315.2	256
Sub-total	8 333.8	6 757
TOTAL	131 469.3	106 584

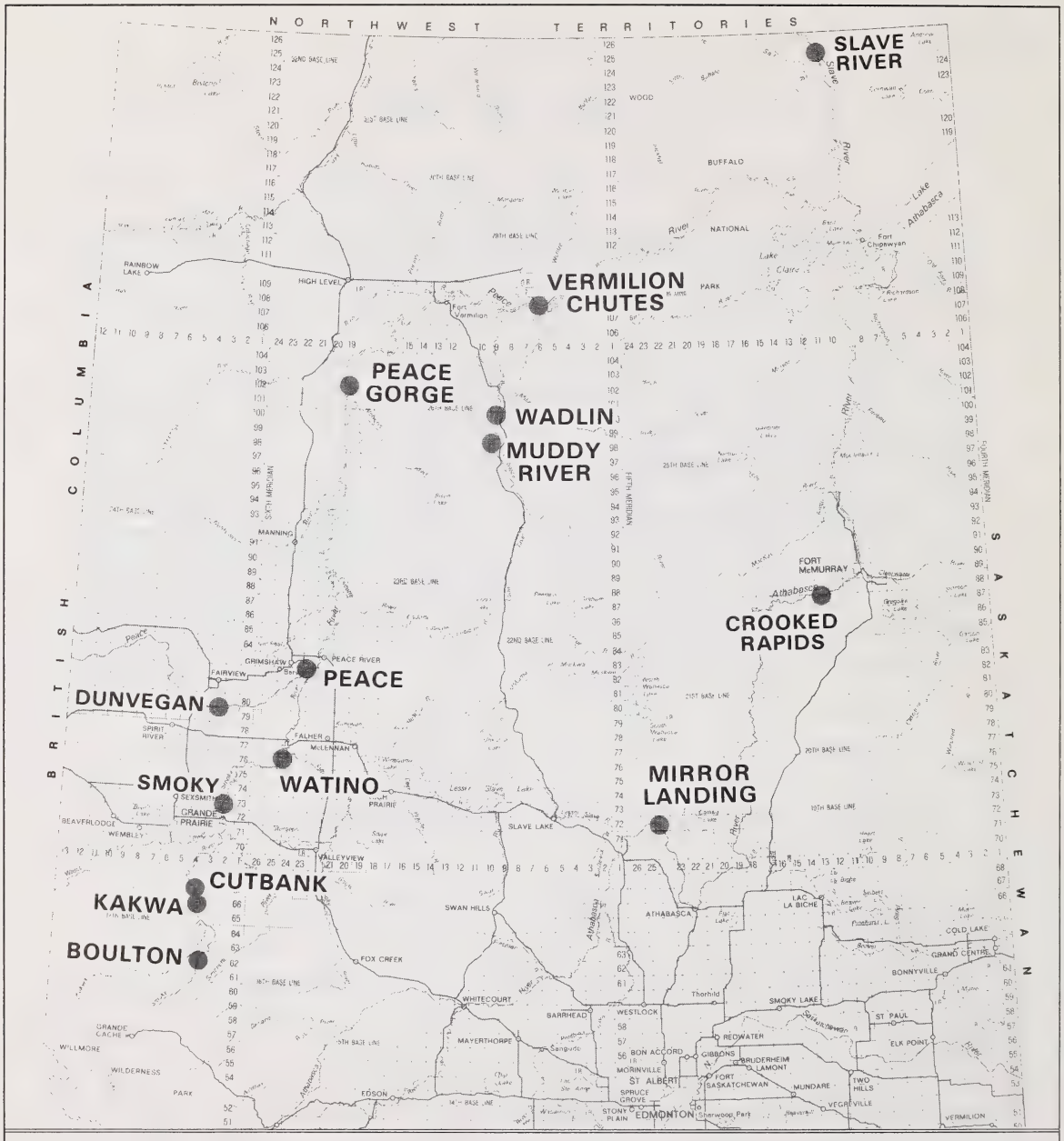


Figure 10.1 Potential Hydro-electrical Sites.

11. RECREATION

Northern Alberta has a tremendous potential for extensive forms of recreation as well as a number of high-quality recreation areas. Development to date has been very localized and primarily concentrated in the Edmonton area.

Development for recreation is provided by a number of sources. Alberta Provincial Parks establishes facilities for outdoor recreation, nature conservation, and heritage appreciation. The Alberta Forest Service provides resource oriented, dispersed, extensive recreation opportunities with overnight and day-use, water based and land based opportunities. Alberta Transportation provides small, minimally maintained facilities designed as dayrest and overnight sites. If these sites evolve into destination areas due to nearby attractions, management is usually transferred to Alberta Provincial Parks. Municipal facilities (municipalities, cities, towns, counties, IDs, MDs) provide recreational and open space opportunities at a local level, usually designed for local use and often reflecting traditional use of area facilities. Parks Canada designs and manages national parks to protect representative examples of the diversity of Canada's landscape for present and future generations. Private operators provide a wide variety of facilities. Table 11.1 gives an estimate of these various types of facility by Alberta Energy and Natural Resources regions. More than half of the facilities are located within the North-East Region. Figure 11.1 shows the national and provincial parks and campsites in northern Alberta in 1982.

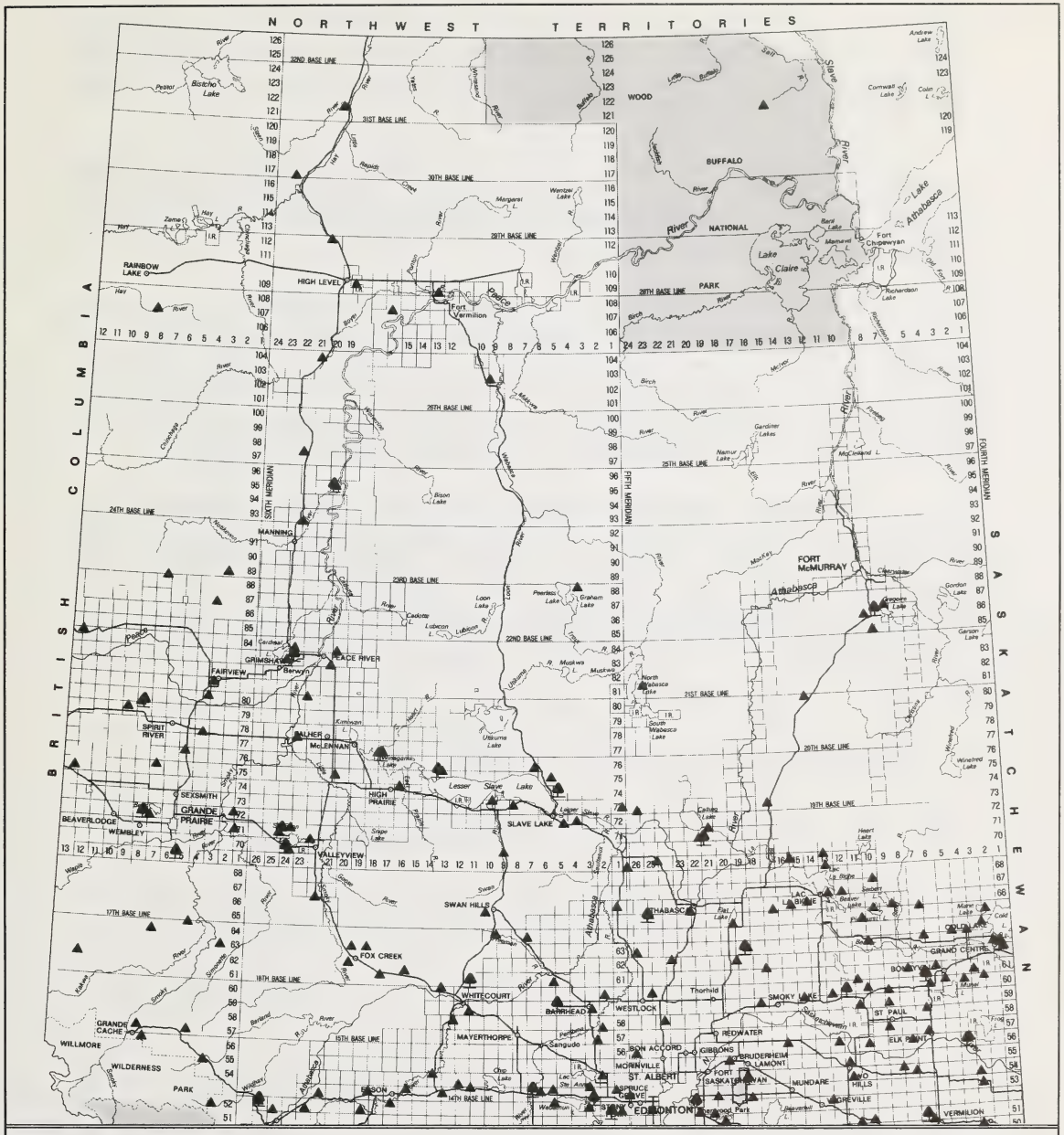
Highlights of northern Alberta's recreational potential include Willmore Wilderness Park, Wild Kakwa, and the Lakeland area (which could be particularly important in providing lake-based cottaging). Travel Alberta has commissioned six Destination Area Studies which overlap or fall within northern Alberta. Opportunities (in addition to the highlights) identified in these studies focus on such aspects as hunting, fishing, boating/canoeing, along with associated expanded guiding, transportation and service oriented activities, and emphasizing the numerous resources connected with the historic and recreational waterways. In addition, several of the studies identify the possibility of "diverting and detaining" the market traveling through northern Alberta along the Yellowhead and Alaska highways for enroute breaks of one or more days. Increased availability or

Table 11.1

CAMPING FACILITIES

	Athabasca Region	Northeast Region	Peace River Region	Total
Provincial Parks	1	14	9	24
Roadside Areas *	1	81	25	107
Alberta Forest Service	11	17	32	60
National Parks	1	1	0	2
Private and Municipal	0	29	6	35
TOTAL	14	142	72	228

* Established originally by Alberta Transportation, roadside areas are transferred to Alberta Recreation and Parks when use levels indicate that the areas are used as destination points rather than stop-over sites.



RESOURCE DEVELOPMENT OPPORTUNITIES IN NORTHERN ALBERTA

ENERGY AND NATURAL RESOURCES

SCALE 1: 4 000 000

Figure 11.1 National Parks, Provincial Parks and Campsites, 1982.

visibility of information on recreation opportunities such as detailed guides for paddling the rivers and other tourist information may help to increase use (such as identifying good fishing areas, hunting areas and associated, existing services).

There is good opportunity in northern Alberta for private tourism development (e.g., cottaging, hunting and fishing lodges) based on the wildlife, fishing, boating, relatively undeveloped wilderness and cultural/historical resources.

Table 11.2 lists tourism opportunities identified in a tourism conference organized by the Northern Alberta Development Council in December, 1984. As was addressed at the conference, a major advantage of many of these opportunities is that they are not all major developments requiring large capital or operating expenditures but could be carried out by small investores or community groups.

Currently, recreation demand tends to be very localized and primarily confined along major existing access routes. Recreation and/or tourism is highly dependent on access. Development of highways and associated services in a pattern which encourages circle tours (i.e. not retracing routes) within northern Alberta or in conjunction with the surrounding areas would tend to increase tourism and recreational use.

Table 11.2

TOURISM OPPORTUNITIES IN THE NORTH

Outdoor recreation -- camping, hiking

Water activities in many areas

Big game hunting -- guiding and outfitting

Sport fishing

Sight-seeing and bird-watching

Winter activities like cross-country skiing, ice fishing, and snowmobiling

More locations where fly-in lodges could be located

Riverboat cruises on the Peace, the Athabasca, and the Smoky

Historical sites development such as at Dunvegan and Fort George/Buckingham house

Wilderness experience potential at Fort Chipewyan, for example, outfitting, dogsledding, native culture

The Cold Lake region as a major recreation/resort area

Source: Northern Alberta Development Council. 1985. Tourism North: Conference Report.

12. OBSERVATIONS AND INTERPRETATION

When looked from this broad level, many large development opportunities appear possible. Important smaller opportunities are not identified. Most of the major evident ones have common constraints:

- A significant financial outlay is required to develop the potential (private or public funds).

- Unknown/changing conditions outside of Alberta influence the viability of major developments.

- The biological resource base over the region does not have the higher inherent capabilities to sustain production levels as achieved in southern Alberta.

- The undeveloped resources in northern Alberta, while not concentrated in area, are large in scale due to the lack of appreciable utilization to date.

- There is a dependence on access and transportation for all potential developments. (Both physical access to the resources and economic access to markets.) Because the resources are not concentrated, any transportation system or network must be designed to maximize utility to a combination of uses to be efficient.

- There are differences in the region in terms of employment and lifestyle values. These would influence possible development in both positive and negative ways, depending on the area. (The human resources now in the region and possible future populations would be an integral part of any development strategy.)

- The present employment picture in the region appears to be highly "integrated"; thus changes in the type of employment opportunities in the region need to consider the relationships between the various sectors.

- There are opportunities that might require the same land or resource base. At this time, there appears to be room to utilize the resources to the best advantage with limited conflict.

The most basic conclusion to be made from looking at the development opportunities in northern Alberta at this scale is the interdependence that each has with the other through factors such as the resource base itself, and also through factors of human resources, outside-area influences and transportation. Development direction and realization of benefits can only be done within some joint framework including government and commercial sectors.

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